RESEARCH

Comparison of bond strengths of self etch adhesive systems in orthodontic bracket bonding procedures

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ABSTRACT

Comparison of bond strengths of self etch adhesive systems in orthodontic bracket bonding procedures

Background: The aim of this *in-vitro* study was to compare shear bond strength (SBS) of the self etch adhesive systems.

Methods: 100 extracted human mandibular third molar teeth randomly divided into five groups in this study (n=20). Maxillary first premolar brackets were bonded onto mesio-buccal and disto-buccal surfaces of every molar tooth (control and experimental side). For all groups randomly selected control sides were bonded with total etch system. In experimental side Group I bonded with Transbond Plus SEP (3M Unitek, Monrovia, California, USA); Group II, Clearfil S3 Bond Plus (Kuraray Medical, Tokyo, Japan); Group III, Clearfil S3 Bond (Kuraray Medical, Tokyo, Japan); Group IV, Ortho Solo (Ormco Glendora, California, USA); Group V, AdheSE (Ivoclar, Vivadent AG, Liechtenstein). The teeth were stored in distilled water at 37 °C for 24 hours. After 5000 rounds of thermocycling, SBS test was performed using a universal testing machine at 1 mm/min crosshead speed. Data were analyzed with one way analyses of variance and post-hoc Tukey test.

Results: Statistically analysis showed a significantly difference between decreased strength value of self etch adhesive systems according to the total etch (P<0.05). Group II (%30.1) had the lowest decreased shear bond strength. There were no significant difference between Group II and Group I (%31.95). Group III (%36.65) had lower decreased shear bond strength than g-Group V (%40.3). Decreased shear bond strength of Group IV (%49.5) was significantly highest than the other groups.

Conclusion: Shear bond strength of total etch adhesive systems was better than self etch adhesive systems. But some manufacturer's self etch adhesive had a satisfactory bond strength for clinical use.

KEYWORDS

Bonding, self etch adhesive system, shear bond strength

ÖZ

Ortodontik braketlerin bağlanmasında kendinden pürüzlendirmeli adeziv sistemlerin bağlanma dayanımlarının karşılaştırılması

Amaç: Bu *in vitro* çalışmanın amacı kendinden pürüzlendirmeli (self-etch) adeziv sistemlerin bağlanma dayanımlarının karşılaştırılmasıdır.

Gereç ve Yöntemler: Bu araştırmada, çekilmiş 100 tane insan üçüncü mandibular molar dişi rastgele 5 gruba ayrıldı (n=20). Her dişe, mezio-bukkal ve disto-bukkal yüzeylerinde olacak şekilde üst birinci premolar braketleri yapıştırıldı (kontrol ve deney grubu). Tüm gruplarda, rastgele seçilen kontrol yüzeyleri total etch sistem ile bondlandı. Deney grubunda, bonding ajanı olarak Grup I'de Transbond Plus SEP (3M Unitek, Monrovia, California, USA); Grup II'de Clearfil S3 Bond Plus (Kuraray Medical, Tokyo, Japan); Grup III'de Clearfil S3 Bond (Kuraray Medical, Tokyo, Japan); Grup IV'de Ortho Solo (Ormco Glendora, California, USA); Grup V'de AdheSE (Ivoclar Vivadent AG, Liechtenstein) kullanıldı. Braketleme sonrası dişler 24 saat 37° C distile suda bekletilip, termal siklus cihazında yapılan 5000 tur sonrasında, hızı 1 mm/dk olan universal test cihazında shear testi yapıldı. İstatistiksel değerlendirme tek yönlü varyans analizi ve Tukey testleri ile yapıldı.

Bulgular: İstatistiksel analizler self etch sistemlerin total etch sisteme göre azalan bağlanma dayanımları arasında anlamlı bir fark olduğunu gösterdi (P<0.05). Grup II (%30,1) en az bağlanma dayanımı kaybına sahip olmakla beraber Grup I (%31,95) ile arasında anlamlı bir farklılık gözlenmedi. Grup III'ün (%36,65) bağlanma dayanımı kaybı Grup V'e (%40,3) göre daha düşük bulundu. Grup IV (%49,5) ise diğer gruplara göre en fazla bağlanma dayanımı kaybı gösterdi.

Sonuç: Total etch sistem ile yapıştırılan braketlerin bağlanma dayanıklılıkları self etch sistemlerinkine göre daha iyidir. Ancak bazı firmaların ürettiği self etch sistemler klinik olarak memnun edici bağlanma dayanımı göstermektedir.

ANAHTAR KELİMELER

Bağlanma, kendinden pürüzlendirmeli adeziv sistem, makaslama bağlanma dayanımı

Adhesion between tooth enamel and orthodontic brackets is a significant point in clinical orthodontic treatment. The development of acid etch system in 1955 by Buonocore[1] was a milestone for bonding system in dentistry but it was Newman[2] who introduced bonding system to orthodontic society. Many developments have occurred ever since. Traditional orthodontic adhesive system included 3 step that known as total etch technique, consist of acid etching, primer solution (unfilled resin) and adhesive (resin composite) to bond brackets to enamel.[3] Bonding procedures that using phosphoric acid have shown

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disadvantages such as; increased enamel loss, enamel cracks, enamel decalcification and white spot lesion incidence.[4-7] New generation bonding systems have been produced to improve the adhesion ability and simplify the bonding methods overtime.[8] Self etch primers (SEPs) have been also manufactured to improve the bonding procedures. SEPs, which combine acid and primer into a single solution, reduce chair time, avoid the side effects of acid and simplify the bonding procedure as an alternative to total etch bonding system.[9,10]

Adhesion of SEPs on enamel is generally less than on dentin, and, although clinically acceptable, lower values for shear bond strength (SBS) were reported when compared with total etch systems.[11,12] The priority in orthodontics is to return the original enamel surface after removal of the orthodontic attachments.[13] For this reason new self etching systems become a part of the orthodontic practice. Another important point in orthodontic bonding is cleaning up teeth after bracket removal. Although total etch system still seems to be most frequently used before bonding, enamel damage after debonding still is a major clinical problem.[14] It was reported that, after the use of total etch system, more adhesive remained on the enamel surface after debonding than after SEPs.[6,15-17] Also cleaning up the remnant composite after brackets removal increase clinicians chair time.

The purposes of this *in-vitro* study were to detect and compare the SBS of orthodontic brackets bonded with different self etch systems and total etch system. In addition, the adhesive remnant index (ARI) was used to determine mode of failure, and the enamel surfaces were observed with an optical microscope.

MATERIALS AND METHODS

Preparation of samples

Regional Ethical of Dentistry Faculty of Selcuk University approved this study. The power analysis was established by G*Power (ver. 3.1.10; Franz Faul, Christian-Albrechts-Universität, Kiel, Germany) software. Based on the 1:1 ratio between groups, a total sample size of 100 teeth was found to impart more than 85% (actual power 89.61%) power in order to detect significant differences with a 0.40 effect size at the $\alpha = 0.05$ significance level.

A total of 100 freshly extracted mandibular 3rd molars were collected and stored in 0.1% (wt/vol) thymol solution no longer than 1 month and then stored distilled water until the use. The criteria for tooth selection were no previous chemical agents, no restorations, no caries and no cracks on the buccal surface of teeth, and sufficient root length to allow embedding acrylic resin. Buccal surface of teeth were polished with pumice and rubber polishing cup with a slow-speed hand piece. The enamel surfaces were rinsed with water to remove pumice or debris and then dried with an oil-free air stream.

Bonding procedures

In total, stainless steel 200 maxillary first premolar brackets (Equilibrium 2® Dentaurum, Ispringen, Germany) were bonded randomly onto mesio-buccal and disto-buccal surfaces of every molar teeth by the same operator (EAE).

The teeth were randomly divided into 5 groups of 20 specimens. In all groups, mesio-buccal surfaces of half of the teeth were bonded with experimental primer agent and disto-buccal surfaces of the teeth bonded with control agent (total etch system) randomly. The other half of the teeth was bonded oppositely to eliminate structural differences that occur in the enamel surface. All bonding processes were performed according to the manufacturers' directions. Each bracket was bonded by using self-generated composite of the bonding agent.

In control sides, the enamel surfaces were etched with 37% phosphoric acid (3M Dental Products, St Paul, MN) for 15 seconds, and then teeth were rinsed with a water spray, finally were dried until chalky white appearance. Transbond XT light cure primer (3M Unitek, Monrovia, Calif) was applied to the etched surfaces. Brackets were bonded with Transbond XT adhesive, light cured for 20 seconds using an LED unit (Elipar™ S10 LED Curing Light, St. Paul, MN, USA). In experimental sides the teeth were conditioned with self etch adhesive systems according to the each manufacturers' instructions. The groups were as follows:

Group I: Transbond Plus SEP (3M Unitek) that uses a lollipop system, was applied onto experimental sides of every molar teeth for 15 seconds. The brackets were then bonded with Transbond XT (3M Unitek) resin and light cured for 20 seconds.

Group II: Clearfil S3 Bond Plus (Kuraray Medical, Tokyo, Japan) was applied onto experimental sides of every molar teeth for 15 seconds. The brackets were bonded with Kurasper F (Kuraray Medical) adhesive and light cured for 20 seconds.

Group III: Clearfil S3 Bond (Kuraray Medical, Tokyo, Japan) was applied onto experimental sides of every molar tooth for 20 seconds. The brackets were bonded with Kurasper F (Kuraray Medical) adhesive and light cured for 20 seconds.

Group IV: Ortho Solo (Ormco, Glendora, California, USA) was applied onto experimental sides of every molar teeth for 20 seconds. The brackets were bonded with Blugloo (Ormco, USA) adhesive and light cured for 20 seconds.

Group V: AdheSE (Ivoclar, Vivadent AG, Liechtenstein) was applied onto experimental sides of every molar teeth once the enamel was completely coated with the primer and was brushed on the entire surface for 15 seconds (the total reaction time should not be shorter than 30 seconds) and dried with a strong stream of air until the mobile liquid film was no longer visible. The bond was applied and dispersed with a gentle stream of air, and it was light cured for 10 seconds. The brackets were bonded with Heliosit Orthodontic (Ivoclar, Liechtenstein).

The teeth were fixed in acrylic resin, and a mounting jig was used to align the facial surface of the tooth to be parallel to the force during the SBS test. All specimens were stored in distilled water at 37 °C for 1 day after brackets were bonded and later subjected to thermocycling 5000 times in distilled water between 5 °C and 55 °C, with a dwell time in each bath of 30 seconds and a transfer time of 15 seconds. Following the thermocycling procedure shear bond test was performed. The test was performed by using a chisel edge, mounted on the crosshead of a universal testing machine (Elista TSTM 02500, Elista Corp, Istanbul, Turkey) at 1 mm/min crosshead speed. The maximum shear force necessary to debond was obtained in Newton and then converted into megapascal (MPa).

The amount of adhesive left on the enamel surface was examined under an optical microscope (CX41, Olympus, Tokyo, Japan) at 40x magnification. The adhesive remnant index (ARI) was determined as follows: **(1)** All adhesive remaining on the enamel surface; **(2)** More than 90% and less than 100% of the adhesive remaining on the enamel surface; **(3)** Between 10-90% of the adhesive remaining on the enamel surface; **(4)** Less than 10% and more than 0% of the adhesive remaining on the enamel surface; and **(5)** No adhesive remaining on the enamel surface.

Statistical analysis

SPSS version 20.0 (SPSS Inc, Chicago, IL) was used to perform all statistics. The Shapiro-Wilks test for normality and Levene variance homogeneity test were applied to the data. Parametric tests were used, due to all parameters were distributed normally and homogeny. In intra-group comparison was evaluated by using independent sample t test. In inter-group mean differences comparisons were evaluated by using one-way analysis of variance (ANOVA) and post-hoc Tukey multiple comparison tests. For the ARI scores, the chi-squre test was used to identify any significant differences among the groups.

RESULTS

Statistical comparison and descriptive statistics including mean, standard deviation, minimum and maximum values of SBS were shown in Table 1. There were significant differences between experimental and control sides in all groups ($P<0.01$). The SBS values of control sides were highest then experimental sides in all groups. Statistical comparison of percentage of decreased SBS values between control and experimental sides were shown in Table 2. There were significant differences between groups according to the percentage of decreased SBS values. The least decreased SBS values were shown in Group I and III then Group II and V. The maximum decreasing SBS value was shown in Group IV. In Group IV SEP had approximately half of the control side SBS values.

Table 1.

Mean and standard deviation (SD) of the SBS values (MPa) according to the surface treatments

Groups		N	Mean	SD	Min-Max	Sign
Group I	Control	20	20.89	2.54	15.86-25.46	**
	Experimental	20	12.76	1.69	8.64-15.34	
Group II	Control	20	17.75	2.22	13.65-21.34	***
	Experimental	20	10.29	2.14	7.12-14.84	
Group III	Control	20	18.45	2.85	14.48-23.51	***
	Experimental	20	12.57	2.02	9.12-16.82	
Group IV	Control	20	17.49	2.55	13.74-22.62	***
	Experimental	20	8.84	2.21	5.24-13.56	
Group V	Control	20	18.04	3.07	13.72-24.45	***
	Experimental	20	10.42	1.84	6.83-14.32	

Table 2.

Statistical comparison of percentage of decreased SBS values between control and experimental side

Groups	N	Mean (%)	SD	Min-Max	Sign	
					ANOVA	TUKEY
Group I	20	31.95	2.24	28.42-35.28	P<0.022 F=8.013	A
Group II	20	36.65	2.12	32.68-40.45		B
Group III	20	30.10	2.64	26.22-35.31		A
Group IV	20	49.50	3.14	44.94-54.72		C
Group V	20	40.03	4.47	37.28-44.34		B

The frequency distributions of ARI scores were shown in Table 3. According to the chi-square test, there were significant differences between control and experimental sides in all groups. With regard to ARI scores, shear was occurred between resin and enamel especially in experimental side according to the control side.

Table 3.

The frequency distributions of ARI scores according to the Chi-square test

Groups		N	1	2	3	4	5	Sign	
								Chi-square	p *value*
Group I	Control	20	5(25%)	4(20%)	11(55%)	0	0	33.143	***
	Experimental	20	0	0	2(10%)	8(40%)	10(50%)		
Group II	Control	20	4(20%)	4(20%)	6(30%)	4(20%)	2(10%)	23.400	***
	Experimental	20	0	0	0	6(30%)	14(70%)		
Group III	Control	20	4(20%)	4(20%)	10(50%)	2(10%)	0	33.600	***
	Experimental	20	0	0	0	8(40%)	12(60%)		
Group IV	Control	20	4(20%)	6(30%)	8(40%)	2(10%)	0	34.000	***
	Experimental	20	0	0	0	6(30%)	14(70%)		
Group V	Control	20	4(20%)	6(30%)	6(30%)	2(10%)	2(10%)	26.844	***
	Experimental	20	0	0	0	7(35%)	13(65%)		

DISCUSSION

This study was undertaken to evaluate the effectiveness of five self etching adhesive systems in bonding orthodontic brackets by comparing their SBS and ARI scores with total etch bonding system that include 37% phosphoric acid. All of the brackets were bonded with SEP's manufacturers' suggested adhesive paste to compare the manufacturers own adhesion forces.

Pumicing is an important procedure before bonding orthodontic brackets.[18] Studies have indicated that pumice prophylaxis improves bond strength when using SEP in bracket bonding procedure.[19,20] Thus, all bonding systems were followed by application of pumice prophylaxis to the surfaces.

There are 5 groups and each group as the control group (total etch bonding system) and the experimental group (self etch bonding system) were analyzed with two different bonding materials. Previous studies examined SBS of orthodontic brackets on extracted different teeth. However, the teeth either in the same patient or taken from different patients can cause different bond strengths of the distinctions in the structures of enamel. Also the comparison to be carried out on the same tooth gives more reliable results. In our study extracted molar teeth were used to take advantage of mesio-distal width. Mesial and distal surfaces of every single tooth were bonded in order to eliminate the effects of SBS in different enamel structure as much as possible.

The bonding materials that used in this study were evaluated that have stronger bond strength according to the required minimum bond strength for orthodontic treatment. Studies indicate that using 37% phosphoric acid in bonding procedure increases SBS.[15,18] Similarly, in this study, control group (total etch bonding system) has the strongest bond strength compared with other groups, and was significantly higher than other groups that bonding with SEP systems. When we compared the SEP systems, the Clearfil S3 Bond and Transbond Plus SEP showed the most closest SBS to the control group (30.10% and 31.95%). Clearfil S3 Bond Plus and AdheSE followed them (36.65% and 40.03%). According to the control group the lowest SBS was shown on Ortho Solo SEP systems. Even so, the all groups mean SBS values might be still clinically acceptable.

Although total etch system had higher bond strength, there are many disadvantages. The use of phosphoric acid causes loss of sound enamel, more white spot lesions near the bracket during treatment and enamel cracking, because of the high bonding strength while debonding procedure.[21,22] Therewithal debonding procedure of the control groups usually needs more chair time consequence of higher ARI scores of total etch system than SEP systems. Also higher ARI scores cause more residual adhesive materials on the enamel with the result that time loss during the bonding procedure and increase the risk of enamel scratches. We found significant differences in the ARI scores between control sides and experimental sides. In the experimental groups, there were no score of 1 and 2. These results suggest that the union between Transbond XT and the bracket was stronger than that between the enamel and the adhesive in experimental groups.

Many studies have shown that when SEPs are used, the degree of penetration by the adhesive to the etched enamel is less than with the use of a conventional acid-etch technique. The more deeply the

enamel surface is penetrated by the adhesive, the greater the penetration of the adhesive and the greater the risk of damage to the enamel during debonding.[12,23,24] It is a common belief that bracket bond strength must be within a certain limit. High bond strength causes enamel fractures while debonding, low bond strength causes accidental debonding during treatment. The point to note the maximum bond strength of an orthodontic bracket should be less than the fracture resistance of the enamel, which is about 14 MPa.[25,27] Also studies have shown that shear bond strength of a stainless steel bracket to enamel should be higher than 6 MPa.[25,27] Findings of this study the bond strength of SEP systems were approximately within this range.

Laboratory conditions not represent the oral environmental effect. However some conditions could reverberate the oral environment such as thermocycling, the aim of thermocycling procedure was thermally stressing the adhesive-joint interface. *In vitro* bond-strength testing is not fully representative of intraoral conditions, only can give an idea for the clinical aspect.

Within the limitations of this study, our results suggest that SEPs could be used for bonding brackets to enamel surfaces as an alternative to total etch system, due to its various advantages such as reduced clinical steps, save chair time, improve adhesive procedures, and reduce the risk of decalcification or white-spot formation.

CONCLUSION

Under the conditions of this *in-vitro* study, the following conclusions were drawn:

1. In all groups, self-etching primer systems showed lower bond strength values than conventional acid-etch system.

2. Mean shear bond strength values of all groups were higher than the critical clinically acceptable bond strength.

3. Clearfil S3 Bond Plus and Transbond Plus SEP could be preferred in self-etching primer systems for bonding orthodontic brackets.

REFERENCES

1. Barbosa VL, Almeida MA, Chevitarese O, Keith O. Direct bonding to porcelain. Am J Orthod Dentofacial Orthop 1995; 107: 159-64.
2. Gange P. The evolution of bonding in orthodontics. Am J Orthod Dentofacial Orthop 2015; 147: 56-63.
3. Katona TR, Long RW. Effect of loading mode on bond strength of orthodontic brackets bonded with 2 systems. Am J Orthod Dentofacial Orthop. 2006; 129: 60-4.
4. Lehman R, Davidson C, Dujisters P. *In vitro* studies on susceptibility of enamel to caries attack after orthodontic bonding procedures. Am J Orthod Dentofacial Orthop 1996; 110: 590-7.
5. Hosein I, Sherriff M, Ireland AJ. Enamel loss during bonding, debonding, and clean up with use of a self-etching primer. Am J Orthod Dentofacial Orthop 2004; 126: 717-24.
6. Vicente A, Bravo LA, Romero M. Influence of a nonrinse conditioner on the bond strength of brackets bonded with a resin adhesive system. Angle Orthod 2005; 75: 400-5.
7. Cal-Neto JP, Mendes-Miguel JA. Scanning electron microscopy evaluation of the bonding mechanism of a self-etching primer on enamel. Angle Orthod 2006; 76: 132-6.
8. Grubisa HS, Heo G, Raboud D, Glover KE, Major PW. An evaluation and comparison of orthodontic bracket bond strengths achieved with self-etching primer. Am J Orthod Dentofacial Orthop 2004; 126: 213-9.
9. Bishara SE, Ajlouni R, Laffoon JF, Warren JJ. Comparison of shear bond strength of two self-etch primer/adhesive systems. Angle Orthod 2006; 76: 123-6.
10. Scougall Vilchis RJ, Yamamoto S, Kitai N, Yamamoto K. Shear bond strength of orthodontic brackets bonded with different self-etching adhesives. Am J Orthod Dentofacial Orthop 2009; 136: 425-30.
11. Bishara SE, Gordan VV, VonWald L, Olson ME. Effect of an acidic primer on shear bond strength of orthodontic brackets. Am J Orthod Dentofacial Orthop 1998; 114: 243-7.
12. Bishara SE, VonWald L, Laffoon JF, Warren JJ. Effect of a self-etch primer/adhesive on the shear bond strength of orthodontic brackets. Am J Orthod Dentofacial Orthop 2001; 119: 621-4.
13. Eminkahyagil N, Arman A, Cetinsahin A, Karabulut E. Effect of resin-removal methods on enamel and shear bond strength of rebonded brackets. Angle Orthod 2006; 76: 314-21.
14. Cehreli ZC, Altay N. Effects of a nonrinse conditioner and 17% ethylenediaminetetraacetic acid on the etch pattern of intact human permanent enamel. Angle Orthod 2000; 70: 22-7.
15. Scougall-Vilchis RJ, Yamamoto S, Kitai N, Hotta M, Yamamoto K. Shear bond strength of a new fluoride-releasing orthodontic adhesive. Dent Mater J 2007; 26: 45-51.
16. Al Shamsi A, Cunningham JL, Lamey PJ, Lynch E. Shear bond strength and residual adhesive after orthodontic bracket debonding. Angle Orthod 2006; 76: 694-9.
17. Bishara SE, Oonsombat C, Ajlouni R, Laffoon JF. Comparison of the shear bond strength of 2 self-etch primer/adhesive systems. Am J Orthod Dentofacial Orthop 2004; 125: 348-50.
18. Scougall-Vilchis RJ, Ohashi S, Yamamoto K. Effects of 6 self-etching primers on shear bond strength of orthodontic brackets. Am J Orthod Dentofacial Orthop. 2009; 135: 424.e1-7.
19. Lill DJ, Lindauer SJ, Tufekci E, Shroff B. Importance of pumice prophylaxis for bonding with self-etch primer. Am J Orthod Dentofacial Orthop 2008; 133: 423-6.
20. Burgess AM, Sherriff M, Ireland AJ. Self-etching primers: is prophylactic pumicing necessary? A randomized clinical trial. Angle Orthod 2006; 76: 114-8.
21. Cal-Neto JP, Miguel JA, Zanella E. Effect of a self-etching primer on shear bond strength of adhesive precoated brackets in vivo. Angle Orthod 2006; 76: 127-31.
22. Vicente A, Bravo LA, Romero M, Ortı´z AJ, Canteras M. Effects of 3 adhesion promoters on the shear bond strength of orthodontic brackets: an *in-vitro* study.Am J Orthod Dentofacial Orthop 2006; 129: 390-5.
23. Pus MD, Way DC. Enamel loss due to orthodontic bonding with filled and unfilled resins using various clean-up techniques. Am J Orthod Dentofacial Orthop. 1980; 77: 269-83.
24. Lehman R, Davidson C, Dujisters P. *In vitro* studies on susceptibility of enamel to caries attack after orthodontic bonding procedures. Am J Orthod Dentofacial Orthop. 1996; 110: 590-7.
25. Retief DH. Failure at the adhesive-etched enamel interface. J Oral Rehabil 1974; 1: 265-84.
26. Gillis I, Redlich M. The effect of different porcelain conditioning techniques on shear bond strength of stainless steel brackets. Am J Orthod Dentofacial Orthop 1998; 114: 387-92.
27. Bourke BM, Rock WP. Factors affecting the shear bond strength of orthodontic brackets to porcelain. Br J Orthod 1999; 26: 285-90.

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